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PUBLIC HEALTH REPORTS.

UNITED STATES.

THE DANGER AND PREVENTION OF TETANUS FROM FOURTH OF JULY WOUNDS.

[Prepared by direction of the Surgeon-General.]

By John F. Anderson, passed assistant surgeon, Public Health and Marine-Hospital Service.

For the past five years the Journal of the American Medical Association has, before each Fourth of July, pointed out in its editorial columns, the special danger of tetanus subsequent to wounds incurred in the use of blank-cartridge pistols, toy cannons, firecrackers, and other noise-producing devices. Some time after the Fourth of July, when the full effects can be counted in deaths from tetanus, loss of limbs, burns, loss of eyes and eyesight, etc., it has published as complete a list as possible of the cost to the nation in lives and injuries.

The following table, taken from the Journal,^a shows the number of cases of tetanus following the celebration of the Fourth for the past five years:

Year.	Blank cartridge.	Giant cracker.	Cannon.	Firearm.	Powder, etc.	Total cases.	Total deaths.
1903.....	363	17	5	3	27	415	406
1904.....	74	18	5	1	7	105	91
1905.....	65	17	4	5	13	104	87
1906.....	54	17	1	7	10	89	75
1907.....	52	8	6	4	3	73	73
Total	608	77	21	20	60	786	722

The great decrease in the number of cases from 415 in 1903 to 73 in 1907 must be attributed in large measure to the campaign led by the Journal and ably seconded by the lay press for the more thorough and careful treatment of Fourth of July wounds, and especially the use of tetanus antitoxin as a prophylactic. From the table it will be seen that there have been 786 cases of tetanus, with 721 deaths, a mortality of 92 per cent of those attacked. Six hundred and eight, or 80 per cent, of these followed blank cartridge wounds. The number of cases of lockjaw following blank cartridge wounds has steadily decreased since 1903 from 363 to 52 in 1907, while the cases following other wounds have remained fairly constant. This would seem to indicate that the public is realizing the great danger from blank cartridges.

^a Journal Am. Med. Assn., vol. 49, p. 655.

DISTRIBUTION OF THE TETANUS BACILLUS.

The bacillus of tetanus, or its spore form, is found in earth, especially garden earth, stable manure, the dust of the streets, stables, and human habitations. The feces of healthy animals, such as the horse, cow, dog, and even man, may contain tetanus spores.

Verneuil considers the intestinal tract of the horse the normal habitat of the organism and, as the dust of the streets is largely horse manure, it is easy to see why wounds contaminated in any way by this dust are so liable to be followed by tetanus. Mixed infections are especially dangerous, as other organisms, especially the pus cocci, assist in the production of anaerobic conditions and prevent the leucocytes from destroying the tetanus spores, as may happen when they are inoculated into animals in pure culture.

The tetanus spore is very resistant to heat, as shown by the fact that Theobald Smith has found some strains that resist boiling for 70 minutes. The question of the presence or absence of tetanus bacilli in blank cartridges is discussed pro and con in an article in the *Journal of the American Medical Association*^a and the weight of evidence is certainly in favor of the view that blank cartridges do not contain tetanus bacilli except as a rare contamination when they have been exposed to dirt. There is ample evidence that tetanus spores are present in the street dirt and thus get on the skin and clothing of the injured, and are carried into the wounds by the discharge of the pistol.

PATHOLOGY OF TETANUS.

When tetanus spores are introduced under the skin they at once germinate, if oxygen is excluded, and begin to elaborate tetanus toxin. This toxin consists of at least two poisons—*tetano-lysin* and *tetano-spasmin*; the latter is the poison that causes lockjaw.

The motor nerves have a special affinity for tetanus toxin. As soon as the toxin is produced the adjacent motor nerve-endings at once begin to take it up and transport it to the cord. The lymphatics also absorb much of it and in a short time it appears in the blood, which carries it to all parts of the body, where it is absorbed by the motor nerve-endings which are bathed in the toxin-laden fluid. The nerves supplying the jaws, especially the masseteric, seem to have an exaggerated affinity for the poison, which explains the early trismus. The symptoms are usually earlier and more marked in the limb in which the wound is present, due to the fact that the toxin index is higher there than in other parts of the body. The evidence is decidedly in favor of the view that the toxin produces its effect solely by its absorption by the nerves whose axis-cylinder substance has a specific affinity for the poison; they transport it to the cord and brain through the axis-cylinder substance.

The affinity of the nerves for the toxin and its subsequent binding by them explains why tetanus antitoxin is of very little value after the symptoms have appeared. Antitoxin can, however, neutralize any new toxin that may be formed in cases in which the focus has not been removed.

^aThe Fourth of July, 1903, Casualty List. *Journ. Am. Med. Assn.*, vol. 41, p. 547

The incubation period may be from four or five days to several weeks. If the incubation period is four or five days, death frequently occurs in twenty-four to seventy-two hours. The more prolonged the incubation period is over ten days the better chance there is for recovery. The few cases that do recover are almost invariably those with an incubation period of ten days or more. The mortality of those attacked is from 90 to 95 per cent.

TREATMENT OF FOURTH OF JULY WOUNDS.

Physicians often treat blank cartridge and other Fourth of July injuries, unless of a serious character, as trivial, contenting themselves with picking out the plainly seen pieces of wad, powder, etc., and applying a dressing. In a few days the patient returns with symptoms of tetanus and then, when it is too late, antitoxin is given, the wound is thoroughly cleaned out, and perhaps a piece of wad or clothing found in it.

It should be an invariable procedure that all Fourth of July wounds be laid fully open under local or, preferably, general anaesthesia and all foreign material and necrotic or badly injured tissue removed, as the presence of blood clots and necrotic tissue favor anaerobic conditions, which are essential for the development of the tetanus organism. The use of a constrictor, such as the Esmarch bandage, to prevent hemorrhage during the operation if the wound is on a limb is of much assistance. After the wound has been thoroughly cleaned out it should be swabbed out with strong carbolic acid, at least 25 per cent, followed by a washing with 95 per cent alcohol to prevent further action of the acid. Some surgeons use peroxide of hydrogen instead of carbolic acid. On account of the action of formalin^a on tetanus toxin I think swabbing out the wound with pure formalin after the thorough surgical cleaning out would be an excellent procedure; the pain from the use of formalin soon passes off, and the necrosis caused by it is slight. I hope it will be given a trial by surgeons in Fourth of July wounds.

After cauterization, by whatever method used, the wound should be thoroughly washed out with a 1:1,000 or 1:2,000 solution of bichloride of mercury and packed with gauze soaked in a saturated solution of salicylic or boric acid and a large wet dressing of the same solution applied. In no case should the wound be closed, but it should be allowed to heal by granulation. The dressing and packing should be renewed every day.

TETANUS ANTITOXIN.

Immediately after the wound has been dressed as above at least 1,500 units of tetanus antitoxin should be given. This may be given in the loose tissue of the abdomen, in the buttocks, between the scapulæ, or in any convenient part of the body. It is best to administer the antitoxin while the patient is in the recumbent position. The administration of antitoxin is the most important part of the whole treatment.

^a Anderson, John F.: The antiseptic and germicidal properties of solutions of formaldehyde and their action upon toxins. Hygienic Laboratory Bulletin No. 39, 1907.

The following table, taken from an article by Scherck,^a of St. Louis, shows in a most convincing way the great value of tetanus antitoxin as a prophylactic in Fourth of July wounds:

Cases of Fourth of July wounds treated in St. Louis city dispensaries.

Year.	Cases of wounds treated.	Antitetanic serum used.	Deaths from tetanus.
1903.....	56	None.....	16
1904.....	37	Yes.....	0
1905.....	84	Yes.....	0
1906.....	170	Yes.....	0

It will be seen that in 1903, when no tetanus antitoxin was used, 16 or about 30 per cent of the 56 cases of Fourth of July injuries treated died from tetanus; in 1906, 170 cases of similar injuries were treated, antitoxin being used, *without a single death from tetanus*.

RÉSUMÉ OF TREATMENT.

The procedure reported in the same article by Scherck for the surgical handling of Fourth of July injuries seems to be so satisfactory that I quote it verbatim:

1. To incise freely every wound.
 2. Carefully and thoroughly to remove from the wound every particle of foreign matter.
 3. To cauterize the wound thoroughly with 25 per cent carbolic acid.
 4. To apply loosely a wet pack of 2.5 per cent carbolic acid.
 5. To give a full dose of antitetanic serum.
- The patient was required to return every day for observation and dressing of the wound.

If the various municipalities would pass laws restricting the sale of firearms and ammunition to minors, absolutely prohibit the sale of blank cartridges, toy cannons, and giant fire crackers, and through the lay press educate the people to the great danger of Fourth of July wounds and the importance of thorough surgical treatment and the prophylactic use of *tetanus antitoxin*, many valuable lives would be saved to the nation.

FEDERAL CONTROL OF TETANUS ANTITOXIN.

An act of Congress approved July 1, 1902, provides that establishments engaged in the manufacture and interstate sale of viruses, serums, toxins, and analogous products shall be licensed by the Secretary of the Treasury upon the recommendation of the Surgeon-General of the United States Public Health and Marine-Hospital Service, after inspection by an officer of that service of the stables, laboratories, and methods used and an examination of their products in the Hygienic Laboratory. Samples of the products put on sale by licensed manufacturers are bought at frequent intervals on the open market and examined in the Hygienic Laboratory for purity and potency. Up to October 25, 1907, there was no official standard for testing tetanus antitoxin in the United States; each manufacturer had his own arbitrary method of

^aScherck, H. J.: Antitetanic serum in Fourth of July injuries. Jour. Am. Med. Assn., vol. 47, p. 500.

determining the potency of his products. On that date, however, an American unit was officially promulgated by the Secretary of the Treasury on the recommendation of the Surgeon-General of the Public Health and Marine-Hospital Service.

This American standard^a is the result of several years' work in the Hygienic Laboratory and commends itself on account of its simplicity, directness, and accuracy. The unit is defined as "ten times the least quantity of antitetanic serum necessary to save the life of a 350-gram guinea pig for ninety-six hours against the official test dose of a standard test toxin furnished by the Hygienic Laboratory of the Public Health and Marine-Hospital Service." The Society of American Bacteriologists in December, 1906, adopted a resolution in regard to the standardization of tetanus antitoxin and decided that the minimal immunizing dose for a case of possible tetanus infection should be 1,500 units.

The great need of an official standard for tetanus antitoxin was shown by the examination of samples of serum sold in the United States. It was found, before the adoption of the American unit, that the serums varied extravagantly in unit strength claimed and the actual number of units they contained. Since the unit has been established there has been uniformity in the product and a decided increase in potency. When a physician now buys a package of tetanus antitoxin in the United States he can rest assured that it contains a potent product and the number of units indicated on the label.

[Reports to the Surgeon-General, Public Health and Marine-Hospital Service.]

Reports from San Francisco, Cal.—Plague-prevention work at San Francisco, Oakland, and Berkeley, Cal.

Passed Assistant Surgeon Blue reports:

SAN FRANCISCO, CAL.

Week ended June 6.

Sick inspected	23
Dead inspected	132
Necropsies held	1
Premises inspected	20, 651
Houses disinfected	105
Houses destroyed	1
Buildings condemned	16
Nuisances abated	3, 148
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Rats found dead	265
Rats trapped	4, 735
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Total rats taken	5, 000
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Rats identified:	
Mus decumanus	2, 477
Mus musculus	1, 882
Mus rattus	167
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Total	4, 526
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^a Rosenau, M. J., & Anderson, John F.: The standardization of tetanus antitoxin (an American unit established under authority of the act of July 1, 1902). Bull. No. 43, Hyg. Lab., U. S. Pub. Health and Mar. Hosp. Serv., Wash., 1908. pp. 59.